



Testimony

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and Investigations, Committee on Energy
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NUCLEAR MATERIAL

Several Potential Options
for Dealing with DOE's
Depleted Uranium Tails
Could Benefit the
Government

Statement of Robert A. Robinson, Managing Director
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Highlights

Highlights of [GAO-08-613T](#), a testimony before the Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

Since the 1940s, the Department of Energy (DOE) has been processing natural uranium into enriched uranium, which has a higher concentration of the isotope uranium-235 that can be used in nuclear weapons or reactors. This has resulted in over 700,000 metric tons of leftover depleted uranium, also known as “tails,” that have varying residual concentrations uranium-235. The tails are stored at DOE’s uranium enrichment plants in Portsmouth, Ohio and Paducah, Kentucky. Although the tails have historically been considered a waste product and an environmental liability, recently an about tenfold increase in uranium prices may give DOE options to use some of the tails in ways that could provide revenue to the government.

GAO’s testimony is based on its March 31, 2008, report entitled *Nuclear Material: DOE Has Several Potential Options for Dealing with Depleted Uranium Tails, Each of Which Could Benefit the Government* ([GAO-08-606R](#)). The testimony focuses on (1) DOE’s potential options for its tails and (2) the potential value of DOE’s tails and factors that affect the value. It also contains an analysis of DOE’s legal authority to carry out the potential options.

In its report, GAO recommended that Congress consider clarifying DOE’s statutory authority to manage depleted uranium. GAO also recommended that DOE complete a comprehensive uranium management assessment as soon as possible.

To view the full product, including the scope and methodology, click on [GAO-08-613T](#). For more information, contact Robert A. Robinson at (202) 512-3841 or robinsonr@gao.gov.

NUCLEAR MATERIAL

Several Potential Options for Dealing with DOE’s Depleted Uranium Tails Could Benefit the Government

What GAO Found

DOE’s potential options for its tails include selling the tails “as is,” re-enriching the tails, or storing them indefinitely. DOE’s current legal authority to sell its depleted uranium inventory “as is” is doubtful, but DOE generally has authority to carry out the other options. The department has not finished a comprehensive assessment of these options and is still evaluating the details of how such options might be implemented.

- *DOE’s authority to sell the tails in their current unprocessed form is doubtful.* Because of specific statutory language in 1996 legislation governing DOE’s disposition of its uranium, we believe that DOE’s authority to sell the tails in unprocessed form is doubtful and that, under rules of statutory construction, DOE likely lacks such authority. However, if Congress were to provide the department with the needed authority, firms such as nuclear power utilities and enrichment companies may be interested in purchasing these tails and re-enriching them as a source of nuclear fuel.
- *DOE could contract to re-enrich the tails.* Although DOE would have to pay for re-enrichment, it might obtain more value from selling the re-enriched uranium instead of the tails if its re-enrichment costs were less than the discount it would have to offer to sell the tails as is.
- *DOE could store the tails indefinitely.* While this option conforms to an existing DOE plan to convert tails into a more stable form for long term storage, storing the tails indefinitely could prevent DOE from obtaining the potentially large revenue resulting from sales at currently high uranium prices.

The potential value of DOE’s depleted uranium tails is currently substantial, but changing market conditions could greatly affect the tails’ value over time. Based on February 2008 uranium prices and enrichment costs and assuming sufficient re-enrichment capacity is available, GAO estimates the value of DOE’s tails at \$7.6 billion. However, this estimate is very sensitive to changing uranium prices, which recently have been extremely volatile, as well as to the availability of enrichment capacity.

Uranium Cylinder Storage Yard at DOE’s Paducah Uranium Enrichment Plant



Source: DOE.

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to discuss our work on the Department of Energy's (DOE) inventory of depleted uranium as you consider options for using this inventory in ways that could benefit the U.S. government. As you know, since the 1940s the government has been processing natural uranium into enriched uranium. This increases the concentration of the isotope uranium-235 necessary to make the material useful in nuclear weapons or reactors. The generation of enriched uranium over many decades has resulted in approximately 700,000 metric tons of leftover depleted uranium, also known as "tails," that have varying residual concentrations of uranium-235 remaining. DOE stores these tails at its uranium enrichment plants in Portsmouth, Ohio, and Paducah, Kentucky. DOE is faced with assessing its options to best manage this large accumulation of tails. Although the tails have historically been considered a waste product and an environmental liability, an about tenfold increase in uranium prices in recent years may give DOE options to use that portion of the tails with the higher residual concentrations of uranium-235 in ways that could provide revenue to the government.

My testimony today, which is based on our March 31, 2008, report to the House Committee on Energy and Commerce and the Senate Committee on Energy and Natural Resources,¹ discusses (1) DOE's potential options for beneficially reusing or indefinitely storing its tails and (2) the potential value of DOE's tails and factors that affect the value.

To address these objectives, we reviewed a draft uranium sales strategy that DOE has been developing since 2005, as well as a March 2008 DOE policy statement outlining how the department intends to manage its inventory of uranium—including depleted, natural, and enriched uranium. As part of our evaluation of DOE's potential options, we reviewed relevant statutes and regulations, court decisions, and other legal documents. We also requested DOE's position on its legal authority to implement options for its tails, but DOE declined to provide its position. Appendix I contains our analysis of DOE's legal authority to sell or transfer the tails in their current form, as well as to re-enrich and sell the tails and to store the tails indefinitely. In addition to this legal analysis, we interviewed officials from

¹GAO, *Nuclear Material: DOE Has Several Potential Options for Dealing with Depleted Uranium Tails, Each of Which Could Benefit the Government*, [GAO-08-606R](#) (Washington, D.C.: Mar. 31, 2008).

DOE's Office of Nuclear Energy, which is developing the strategy, and DOE's Office of Environmental Management, which is in charge of the day-to-day management of DOE's uranium inventories stored at Paducah and Portsmouth. We also visited DOE's Portsmouth and Paducah Project Office in Lexington, Kentucky, to discuss depleted uranium management issues with DOE officials. In addition, we interviewed officials from 10 U.S. nuclear power utilities, enrichment services companies such as USEC, and others in the nuclear industry regarding their commercial interests in the tails. To estimate the potential value of DOE's tails, we developed a model using standard formulas for the amounts of enriched uranium and tails produced from given quantities of uranium and enrichment services. We obtained data from DOE on the quantities and uranium-235 concentrations of tails in the department's inventory. The model also used uranium price data obtained from nuclear industry trade publications. These data are commonly used in the nuclear industry as standard measures of the market price for uranium; we determined that the data were sufficiently reliable for our purposes.

We conducted our work from July 2007 to March 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In summary, we found the following:

DOE's potential options for its tails include selling the tails "as is," re-enriching the tails, or storing them indefinitely. However, DOE's current legal authority to sell its depleted uranium inventory in its current unprocessed form is doubtful, and under rules of statutory construction, DOE likely lacks such authority. We found that DOE generally has authority to carry out the re-enrichment and storage options. The department has not finished a comprehensive assessment of these options and is still evaluating the details of how such options might be implemented.

- *DOE's authority to sell the tails in their current unprocessed form is doubtful.* Because of specific statutory language in 1996 legislation governing DOE's disposition of its uranium, we believe that DOE's authority to sell the unprocessed tails is doubtful. DOE may only sell or transfer uranium in a manner consistent with the provisions of the statute.

While the statute authorizes and regulates DOE's sale or transfer of a number of types of uranium, it does not specify conditions for the sale or transfer of depleted uranium tails. Therefore, under rules of statutory construction, DOE likely lacks such authority. However, if Congress were to provide the department with the needed authority, firms such as nuclear power utilities and enrichment companies may be interested in purchasing these tails and re-enriching them as a source of nuclear fuel. Industry officials told us that buyers would discount, perhaps steeply, their offered prices to make buying tails attractive compared with purchasing natural uranium on the open market. That is, DOE might get a discounted price for the tails to compensate buyers for additional risks, such as rising enrichment costs or buyers' inability to obtain sufficient enrichment services.

- *DOE could contract to re-enrich the tails.* Although DOE's authority to sell the unprocessed tails is doubtful, no such general legal impediment exists for the department to itself contract to re-enrich the tails and sell the resulting uranium. Although DOE would have to pay for re-enrichment, it could be better off selling the re-enriched uranium instead of the unprocessed tails if its re-enrichment costs were less than the discount it would have to offer to compensate a buyer for the risks associated with arranging for re-enrichment.
- *DOE could store the tails indefinitely.* DOE also has the general legal option to store the tails indefinitely. While this option conforms to an existing DOE plan to convert tails into a more stable form for long-term storage, storing the tails indefinitely could prevent DOE from obtaining the potentially large revenue resulting from sales at currently high uranium prices. It would also continue to incur associated storage and maintenance costs that currently amount to about \$4 million per year. Moreover, after converting the tails to a more stable form, DOE would incur higher costs to re-enrich the tails if it decided later to pursue such an approach. This is because DOE would have to chemically reconvert the tails to the uranium compound required for re-enrichment.

DOE has not completed a comprehensive assessment to decide among its sales, re-enrichment, or storage options. The department has been developing a uranium management plan since 2005 and issued a March 2008 policy statement that established a general framework for how DOE plans to manage its uranium inventories. However, the policy statement is not a comprehensive assessment of the options for DOE's tails. For example, the policy statement does not discuss whether it would be more advantageous to sell the higher-concentration tails as is (if authorized) or

to re-enrich them, and it does not contain details on when any potential sales or re-enrichment may occur.

The potential value of DOE's depleted uranium tails is currently substantial, but changing market conditions could greatly affect the tails' value over time. Based on February 2008 uranium prices and enrichment costs and assuming sufficient re-enrichment capacity was available, we estimate DOE's tails to have a net value of \$7.6 billion. This estimate is very sensitive to changing uranium prices, which recently have been extremely volatile, as well as to the availability of enrichment capacity. For example, using the lowest and highest uranium prices over the past 8 years, our model shows the value of DOE tails could range from almost nothing to more than \$20 billion. In addition, excess re-enrichment capacity currently is very limited, and the amount of available re-enrichment capacity for tails over the next decade is uncertain. Accordingly, the actual amount of revenue that DOE could obtain from the tails could be much higher or lower than our \$7.6 billion estimate, depending upon uranium prices at the time the material is marketed and the department's ability to obtain sufficient enrichment services, as well as the price of those services.

We recommended that Congress consider clarifying DOE's statutory authority to manage depleted uranium, including explicit direction about whether and how DOE may sell the tails in their current form. Depending on the terms of such legislation, this could reap significant benefits for the government because of the potentially large amount of revenue that could be obtained. In any event, enacting explicit provisions regarding DOE's disposition of depleted uranium would provide stakeholders with welcome legal clarity and could help avoid litigation that would interrupt DOE's efforts to obtain maximum value for its tails. We also recommended that DOE complete a comprehensive uranium management assessment as soon as possible to best take advantage of recent increases in uranium prices.

In its review of our report, DOE did not comment either on our finding that DOE's legal authority to sell or transfer depleted uranium in its current form is doubtful or on our recommendation that Congress consider clarifying DOE's statutory authority to manage depleted uranium. Although DOE officials did not agree or disagree with our recommendation that the department complete a comprehensive uranium management assessment as soon as possible, they did request that we clarify the recommendation to more explicitly outline what the assessment should contain. We agreed and modified the report accordingly.

Background

Since the 1940s, one mission of DOE and its predecessor agencies has been processing uranium as a source of nuclear material for defense and commercial purposes. A key step in this process is the enrichment of natural uranium, which increases its concentration of uranium-235, the isotope of uranium that undergoes fission to release enormous amounts of energy. Before it can be enriched, natural uranium must be chemically converted into uranium hexafluoride. The enrichment process results in two principal products: (1) enriched uranium hexafluoride, which can be further processed for specific uses, such as nuclear weapons or fuel for nuclear power plants; and (2) leftover “tails” of uranium hexafluoride. These tails are also known as depleted uranium because the material is depleted in uranium-235 compared with natural uranium.²

Since 1993, uranium enrichment activities at DOE-owned uranium enrichment plants have been performed by USEC, formerly a wholly owned government corporation that was privatized in 1998. However, DOE still maintains over 700,000 metric tons of depleted uranium tails in about 63,000 metal cylinders in storage yards at its Paducah, Kentucky, and Portsmouth, Ohio, enrichment plants. It must safely maintain these cylinders because the tails are dangerous to human health and the environment. Uranium hexafluoride is radioactive and forms extremely corrosive and potentially lethal compounds if it contacts water. In addition, DOE also maintains large inventories of natural and enriched uranium that are also surplus to the department’s needs.

Tails have historically been considered a waste product because considerable enrichment processing is required to further extract the remaining useful quantities of uranium-235. In the past, low uranium prices meant that these enrichment services would cost more than the relatively small amount of uranium-235 extracted would be worth. However, an approximately tenfold increase in uranium prices—from approximately \$21 per kilogram of uranium in the form of uranium

²Uranium is categorized by concentration of uranium-235, expressed as a percentage “assay.” Natural uranium has an assay of about 0.7 percent uranium-235. For use in a nuclear reactor or weapon, natural uranium must be enriched to increase its assay to a level required for its ultimate use. For example, low enriched uranium (LEU), which is used in commercial nuclear power reactors, typically has an assay of between 3 and 5 percent uranium-235. Highly enriched uranium (HEU), which is used in nuclear weapons, has an assay of greater than 20 percent uranium-235 and can have an assay of greater than 90 percent. The depleted uranium tails also have varying assays below the 0.7 percent assay of natural uranium. The assay of DOE’s tails range from less than 0.15 to about 0.66 percent uranium-235.

hexafluoride in November 2000 to about \$200 per kilogram in February 2008—has potentially made it profitable to re-enrich some tails to further extract uranium-235. Even with the current higher uranium prices, however, only DOE's tails with higher concentrations of uranium-235 (at least 0.3 percent) could be profitably re-enriched, according to industry officials. About one-third of DOE's tails contain uranium-235 concentrations at that level or higher.

DOE Has Options for the Tails but Has Not Finished a Comprehensive Assessment of Them

DOE's potential options for its tails include selling the tails "as is," re-enriching them, or storing them indefinitely. However, DOE's legal authority to sell the tails in their current form is doubtful. Although we found that DOE generally has authority to carry out the re-enrichment and storage options, the department has not finished a comprehensive assessment of these options, and it is still evaluating the details of how such options might be implemented.

DOE's Legal Authority to Sell the Tails in Their Current Form Is Doubtful

While selling the tails in their current unprocessed form is a potential option, we believe that DOE's authority to conduct such sales is doubtful because of specific statutory language in 1996 legislation governing DOE's disposition of its uranium. Appendix I contains our analysis of DOE's authority to sell or transfer its depleted uranium in its current form, as well as to re-enrich and sell the tails, and to store the tails indefinitely. As our analysis explains, in 1996, Congress enacted section 3112 of the USEC Privatization Act,³ which limits DOE's general authority, under the Atomic Energy Act⁴ or otherwise, to sell or transfer uranium. In particular, section 3112 explicitly bars DOE from selling or transferring "any uranium"—including but not specifically limited to certain forms of natural and enriched uranium—"except as consistent with this section." Section 3112 then specifies conditions for DOE's sale or transfer of natural and enriched uranium of various types, including conditions in section 3112(d) for sale of natural and low-enriched uranium from DOE's inventory. To ensure the domestic uranium market is not flooded with large amounts of government material, in section 3112(d), Congress required DOE to determine that any such inventory sales will not have a material adverse impact on the domestic uranium industry. Congress also required in

³USEC Privatization Act, Pub. L. No. 104-134, § 3112, 110 Stat. 1321-344, 42 U.S.C. § 2297h-10.

⁴Atomic Energy Act of 1954, as amended, 42 U.S.C. §§ 2011 *et seq.*

section 3112(d) that DOE determine it will receive adequate payment—at least “fair market value”—if it sells this uranium and that DOE obtain a determination from the President that such materials are not necessary for national security.

Nowhere, however, does section 3112(d) or any other provision of section 3112 explicitly provide conditions for DOE to transfer or sell depleted uranium. Because section 3112(a) states that DOE may not “transfer or sell any uranium . . . except as consistent with this section,” and because no other part of section 3112 sets out the conditions for DOE to transfer or sell depleted uranium, we believe that under rules of statutory construction, DOE likely lacks authority to sell the tails. While courts have not addressed this question before and thus the outcome is not free from doubt, this interpretation applies the plain language of the statute. It also respects the policy considerations and choices Congress made in 1996 when presented with the disposition of DOE’s valuable uranium in a crowded and price-sensitive market. Finally, this reading of DOE’s authority is consistent with how courts address changes in circumstances after a law is passed: Statutes written in comprehensive terms apply to unanticipated circumstances if the new circumstances reasonably fall within the scope of the plain language. Thus, under the current terms of section 3112, DOE’s sale of its tails would be covered by the statute’s general prohibition on sale of uranium, even if tails were not part of the universe Congress explicitly had in mind when it enacted the statute in 1996.

Should Congress grant DOE the needed legal authority by amending the USEC Privatization Act or through other legislation, firms such as nuclear power utilities and enrichment companies would be interested in purchasing at least that portion of the tails with higher concentrations of extractable uranium-235 as a valuable source for nuclear fuel. Officials from 8 of 10 U.S. nuclear utilities indicated tentative interest in such a purchase. Individual utilities were often interested in limited quantities of DOE’s tails because they were concerned about depending upon a single source to fulfill all of their requirements. Multiple utilities acting together as a consortium could mitigate these concerns and purchase larger quantities of tails. Some enrichment firms also told us of some interest in purchasing portions of the inventory, but their anticipated excess enrichment capacity to process the tails into a marketable form affected both the quantity of tails they would purchase and the timing of any purchase.

Potential buyers suggested various commercial arrangements, including purchasing the tails through a competitive sale, such as an auction, or through negotiations with DOE. However, industry officials told us that buyers would discount, perhaps steeply, their offered prices to make buying tails attractive compared with purchasing natural uranium on the open market. That is, DOE might get a discounted price for the tails to compensate buyers for additional risks, such as rising enrichment costs or buyers' inability to obtain sufficient enrichment services. In addition, potential buyers noted that any purchase would depend upon confirming certain information, such as that the tails were free of contaminants that could cause nuclear fuel production problems and that the cylinders containing the tails—some of which are 50 years old and may not meet transportation standards—could be safely shipped.

DOE Could Re-enrich Its Tails

Although DOE's legal authority to sell the tails in their current form is doubtful, DOE has the general legal option, as discussed in appendix I, of re-enriching the tails and then selling the resulting natural or enriched uranium. DOE would have to contract for enrichment services commercially because the department no longer operates enrichment facilities itself. Furthermore, DOE would have to find a company with excess enrichment capacity beyond its current operations, which may be particularly difficult if large amounts of enrichment processing were required. Within the United States today, for example, the only operating enrichment facility is DOE's USEC-run Paducah, Kentucky, plant, and almost all of its enrichment capacity is already being used through 2012, when the facility may stop operating. USEC and at least two other companies are also constructing or planning to construct new enrichment facilities in the United States that potentially could be used to re-enrich DOE's tails.

Although DOE would have to pay for re-enrichment, it might obtain more value from selling the re-enriched uranium instead of the tails if its re-enrichment costs were less than the discount it would have to offer to sell the tails as is. Enrichment firms with whom we spoke told us they would be interested in re-enriching the tails for a fee. The quantity of tails they would re-enrich annually would depend on the available excess enrichment capacity at their facilities.

Additionally, as noted above, prior to selling any natural or enriched uranium that results from re-enriching tails, DOE would be required under section 3112(d) of the USEC Privatization Act to determine that sale of the material would not have a material adverse impact on the domestic

uranium industry and that the price paid to DOE would provide at least fair market value. Section 3112(d) also would require DOE to obtain the President's determination that the material is not needed for national security.

DOE Could Store the Tails

DOE also has the general legal option, as discussed in appendix I, to store the tails indefinitely. In the late 1990s, when relatively low uranium prices meant that tails were viewed as waste, DOE developed a plan for the safe, long-term storage of the material. DOE is constructing two new facilities to chemically convert its tails into a more stable and safer uranium compound that is suitable for long-term storage. DOE estimates that after the conversion facilities begin operating in 2009, it will take approximately 25 years to convert its existing tails inventory.

Storing the tails indefinitely could prevent DOE from taking advantage of the large increase in uranium prices to obtain potentially large amounts of revenue from material that was once viewed as waste. DOE would also continue to incur costs associated with storing and maintaining the cylinders containing the tails. These costs amount to about \$4 million annually. Sale (if authorized) or re-enrichment of some of DOE's tails could also reduce the amount of tails that would need to be converted and, thereby, save DOE some conversion costs.

Moreover, once the tails were converted into a more stable form of uranium oxide, DOE's costs to re-enrich the tails would be higher if it later decided to pursue this approach. This is because of the cost of converting the uranium oxide back to uranium hexafluoride, a step that would be required for re-enrichment. However, according to DOE officials, after the conversion plants begin to operate, the plants will first convert the lower concentration tails because they most likely will not be economically worthwhile to re-enrich. This would give DOE additional time to sell or re-enrich the more valuable higher-concentration tails.

DOE Has Not Completed a Comprehensive Assessment of Options for Its Tails

DOE has been developing a plan since 2005 to sell excess uranium from across its inventories of depleted, natural, and enriched uranium to generate revenues for the U.S. Treasury. In March 2008, DOE issued a policy statement that established a general framework for how DOE plans to manage its uranium inventories. One feature of this policy statement is the establishment of an annual cap on total uranium sales from all of DOE's inventories. The cap is designed to minimize a material adverse impact on domestic uranium producing companies that could result from

DOE depressing uranium prices by selling large amounts of uranium. Thus, under this policy, the maximum amount of tails that DOE would sell annually will depend on the amount of planned sales from its other uranium inventories. In addition, because most uranium to be used as fuel for U.S. nuclear power plants comes from foreign sources, DOE may also choose to retain, rather than sell, some of its uranium as a reserve stockpile to be used in case of a significant disruption in world supplies.

However, the March 2008 policy statement is not a comprehensive assessment of the sales, re-enrichment, or storage options for DOE's tails. The policy statement lacks specific information on the types and quantities of uranium that the department has in its inventory. Furthermore, the policy statement does not discuss whether it would be more advantageous to sell the higher-concentration tails as is (if authorized) or to re-enrich them. It also does not contain details on when any sales or re-enrichment may occur or DOE's legal authority to carry out those options under section 3112 of the USEC Privatization Act. It also lacks information on the uranium market conditions that would influence any DOE decision to potentially sell or re-enrich tails. Further, it does not analyze the impact of such a decision on the domestic uranium industry, and it does not provide guidance on how a decision should be altered in the event that market conditions change. Although the policy statement states that DOE will identify categories of tails that have the greatest potential market value and that the department will conduct cost-benefit analyses to determine what circumstances would justify re-enriching and/or selling potentially valuable tails, it does not have specific milestones for doing so. Instead, the policy statement states that this effort will occur "in the near future."

DOE's Depleted Uranium Inventory Is Potentially Worth Billions of Dollars, but Many Factors Could Greatly Change Its Value

At current uranium prices, we estimate DOE's tails to have a net value of \$7.6 billion; however, we would like to emphasize that this estimate is very sensitive to changing uranium prices, which recently have been extremely volatile, as well as to the availability of enrichment capacity. This estimate assumes the February 2008 published uranium price of \$200 per kilogram of natural uranium in the form of uranium hexafluoride and \$145 per separative work unit—the standard measure of uranium enrichment services. Our model also assumes the capacity to re-enrich the higher-concentration tails and subtracts the costs of the needed enrichment services. It also takes into account the cost savings DOE would realize from reductions in the amount of tails that needed conversion to a more stable form for storage, as well as the costs to convert any residual tails.

As noted above, this estimate is very sensitive to price variations for uranium as well as to the availability of enrichment services. Uranium prices are very volatile, and a sharp rise or fall in prices could greatly affect the value of the tails. For example, since 2000, uranium prices have varied from a low of about \$21 per kilogram in November 2000 to a high of about \$360 per kilogram in mid-2007, before falling to their recent level of about \$200 per kilogram. Substituting the high and low end of historical uranium prices over the past 8 years for current prices results in a range of values for the tails from being nearly worthless, assuming \$21 per kilogram of uranium, to over \$20 billion, assuming \$360 per kilogram of uranium. There is no consensus among industry players whether uranium prices will fall or rise in the future or on the magnitude of any future price changes. Furthermore, the introduction of additional uranium onto the market by the sale of large quantities of DOE depleted, natural, or enriched uranium—assuming DOE obtains authority to sell depleted uranium—could also lead to lower uranium prices. Therefore, according to DOE officials, DOE’s uranium sales strategy, when completed, will likely call for limits on the quantity of uranium the department would sell annually to help achieve DOE’s goal of minimizing the negative effects on domestic uranium producers. However, this would lengthen the time necessary to market DOE’s uranium, increasing the time the department is exposed to uranium price volatility. These factors all result in great uncertainty of the valuation of DOE’s tails.

In addition, the enrichment capacity available for re-enriching tails may be limited, and the costs of these enrichment services are uncertain. For example, USEC currently only has a small amount of excess enrichment capacity at its Paducah plant. If it used the spare capacity, USEC would only be able to re-enrich about 14 percent of DOE’s most economically attractive tails between now and the possible closing of the plant in 2012. Although USEC officials told us the company was willing to explore options to extend the Paducah plant’s operations beyond 2012 and dedicate Paducah’s capacity solely to re-enriching DOE’s tails after this point, negotiations between the company and DOE would be needed to determine the enrichment costs that would be paid by DOE. The Paducah plant uses a technology developed in the 1940s that results in relatively high production costs. Even if the Paducah plant were to be dedicated entirely to re-enriching DOE tails after 2012, over a decade would be required to complete the work because of limitations on the annual volume of tails that can be physically processed by the plant. This lengthy period of time would expose DOE to risks of uranium price fluctuations and increasing maintenance costs.

USEC and other companies are constructing or planning to construct enrichment plants in the United States that utilize newer, lower-cost technology. However, these facilities are not expected to be completed until various times over the next decade. It is unclear exactly when these facilities will be fully operating, the extent to which they will have excess enrichment capacity to re-enrich DOE's tails, and what enrichment costs DOE could expect to pay. For example, the size of the fee DOE may have to pay an enrichment company to re-enrich its tails would be subject to negotiation between DOE and the company.

Conclusions

Recent dramatic increases in uranium prices present the U.S. government with an opportunity to gain some benefit from material that was once considered a liability. Under current law, however, one potential avenue for dealing with DOE's depleted uranium tails—sale of the material in its current form—is likely closed to the department. Obtaining legal authority from Congress to sell depleted uranium under USEC Privatization Act section 3112 or other legislation would provide the department with an additional option in determining the best course of action to obtain the maximum financial benefit from its tails. We therefore recommended that Congress consider clarifying DOE's statutory authority to manage depleted uranium, under the USEC Privatization Act or other legislation, including explicit direction about whether and how DOE may sell or transfer the tails. Depending on the terms of such legislation, this could reap significant benefits for the government because of the potentially large amount of revenue that could be obtained. In any event, enacting explicit provisions regarding DOE's disposition of depleted uranium would provide stakeholders with welcome legal clarity and help avoid litigation that could interrupt DOE's efforts to obtain maximum value for the tails.

Unfortunately, DOE has not completed a comprehensive assessment of its options with sufficient speed to take advantage of current market conditions. Despite working since 2005 to develop a plan for its uranium inventories, DOE's March 2008 policy statement on the management of its excess uranium inventories lacks detailed information on the types and amounts of uranium that the department plans to potentially sell, further enrich, or store. Although pledging to conduct appropriate cost-benefit analyses as well as analyses on the impact of any proposal on the domestic uranium industry, the policy statement lacks specific milestones for doing so. Because of the potentially significant amounts of revenue that could be obtained from DOE's uranium inventories and the extreme volatility of the uranium market, we recommended that the department complete, as soon as possible, a comprehensive uranium management assessment that

details DOE's options, its authority to implement these options, and the impact of these options on the domestic uranium industry. Without such an assessment that contains detailed information on each of its options, DOE will be unable to quickly react to rapidly changing market conditions to achieve the greatest possible value from its uranium inventories.

Mr. Chairman, this completes my prepared statement. I would be happy to respond to any questions that you or other Members of the Subcommittee may have at this time.

GAO Contact and Staff Acknowledgments

If you have any questions or need additional information, please contact Robert A. Robinson at (202) 512-3841 or robinsonr@gao.gov. Major contributors to this statement were Ryan T. Coles (Assistant Director), Ellen Chu, Terry Hanford, Karen Keegan, Omari Norman, Susan Sawtelle, and Franklyn Yao.

Appendix I: GAO's Legal Analysis of DOE's Current Authority to Manage Depleted Uranium

Introduction and Summary of Conclusions

As part of the Government Accountability Office's review of the Department of Energy's (DOE) potential options for managing its inventory of excess depleted uranium (also known as "tails"), we examined DOE's legal authority to implement three basic options: (1) re-enriching the tails and then selling or transferring them, (2) storing the un-enriched tails indefinitely, and (3) selling or transferring the inventory of tails "as is."

We conclude that DOE has general authority under the Atomic Energy Act to carry out the first and second options—to re-enrich and then sell or transfer the tails, as well as to store them indefinitely. However, we believe that because of constraints on DOE's Atomic Energy Act authority in the USEC Privatization Act, the department's authority to carry out the third option—to sell or transfer the tails in their current form—is doubtful. We believe that under rules of statutory construction, DOE likely lacks such authority under current law.

Because this is an issue of first impression, and because the question could significantly affect the public interest and DOE's development of a comprehensive strategy for its excess-uranium inventory, we recommend that Congress consider enacting legislation clarifying the conditions (if any) under which DOE may sell or transfer its depleted uranium. Depending on the terms of such legislation, this could reap benefits for the government because of the potentially significant revenue that could be obtained. In any event, such clarification would provide stakeholders with

welcome legal clarity, potentially enhance the attractiveness to interested purchasers, and help avoid litigation that could interrupt DOE's efforts to obtain maximum value for the public.¹

Analysis²

A. DOE authority to re-enrich and sell or transfer the tails

DOE has general authority under the Atomic Energy Act of 1954, as amended, 42 U.S.C. § 2011 et seq. (AEA), to re-enrich its depleted uranium inventory to natural or low-enriched levels and then to sell or transfer the re-enriched product. First, AEA section 41, 42 U.S.C. § 2061, authorizes DOE to re-enrich depleted uranium to low-enriched levels, and AEA

¹We also examined whether DOE is authorized to sell or transfer its depleted uranium tails under section 314 of the 2006 Energy and Water Development Appropriations Act, Pub. L. No. 109-103, 119 Stat. 2247, 2281 (Nov. 19, 2005), a position advanced to us by USEC. That provision states in part: "SALES OF URANIUM.—(a) IN GENERAL.—Notwithstanding any other provision of Federal law, including section 3112 of the USEC Privatization Act . . . and section 3302 of title 31, United States Code, [DOE] is authorized to barter, transfer or sell uranium (including natural uranium concentrates, natural uranium hexafluoride, or in any form or assay) and to use any proceeds, without fiscal year limitation, to remediate uranium inventories held by [DOE]."

Without expressing a view on whether these terms might otherwise authorize DOE's sale of its uranium inventories, we conclude that this provision is not permanent legislation and thus not a continuing source of authority, as USEC has suggested. DOE officials told us they agree with this conclusion. Generally, provisions of an annual appropriations act are considered temporary unless Congress indicates otherwise. B-309704, Aug. 28, 2007. The question is whether section 314 contains words of futurity indicating that Congress intended the provision to be permanent. It does not. The language "notwithstanding any other provision of law" refers to other provisions of law in effect during the fiscal year covered by the appropriations act. The language "without fiscal year limitation" authorizes DOE to obligate without fiscal year limitation any proceeds from uranium sold during the period section 314 was in effect. Because section 314 contained no words of futurity, it is no longer in effect. Thus, whatever the scope of authority in section 314, it does not authorize future DOE sales or transfers.

²GAO's practice when rendering legal opinions regarding agency-related matters is to solicit the agency's position on the subject matter of the request. GAO, *Procedures and Practices for Legal Decisions and Opinions*, GAO-06-1064SP (Washington, D.C.: Sept. 5, 2006), available at <http://www.gao.gov/legal/cgdecisions-faq.html> (last visited March 20, 2008). We requested DOE's position on its authority to manage depleted uranium under the Atomic Energy Act and the USEC Privatization Act, as well as any related documents. Letters from Susan D. Sawtelle, GAO Managing Associate General Counsel, to David R. Hill, DOE General Counsel, December 10, 2007, and to Eric J. Fygi, DOE Deputy General Counsel, January 11, 2008. DOE declined to provide its position on these issues. Letter from Eric J. Fygi to Susan D. Sawtelle, December 21, 2007. The department subsequently provided certain documents, Letter from Eric J. Fygi to Susan D. Sawtelle, January 25, 2008, but later told us these did not necessarily reflect the department's legal position.

sections 63 and 66, 42 U.S.C. §§ 2093, 2096—which authorize DOE’s acquisition and distribution of source material—implicitly authorize DOE to re-enrich depleted uranium to natural levels. Second, AEA sections 53, 63, and 161m, 42 U.S.C. §§ 2073, 2093, 2201(m), authorize DOE to transfer this re-enriched uranium, subject to certain conditions, to appropriately licensed entities such as nuclear power reactor operators.

This general AEA authority is limited by any applicable restrictions in the USEC Privatization Act, enacted in 1996. Section 3112(a) of the act, 42 U.S.C. §§ 2297h-10(a), prohibits DOE from transferring or selling “any uranium (including natural uranium concentrates, natural uranium hexafluoride, or enriched uranium in any form) . . . except as consistent with this section.” The remaining provisions of section 3112 then specify the conditions under which DOE may sell or transfer various types of natural and enriched uranium. Thus, DOE is authorized to sell or transfer re-enriched depleted uranium provided such transactions satisfy the remaining section 3112 conditions.

B. DOE authority to store the un-enriched tails indefinitely

DOE has general authority under the AEA to store its unenriched depleted uranium indefinitely, as well as to convert the tails to a more stable form for storage. We believe this authority is implicit under AEA sections 63 and 66, which, as discussed above, authorize DOE to acquire and distribute source material. This authority is also implicit under AEA section 41, which authorizes DOE to enrich uranium, a process which inevitably generates depleted uranium. In addition, to the extent the department’s depleted uranium is “hazardous waste,” AEA section 91a(3), 42 U.S.C. § 2121(a)(3), explicitly authorizes DOE to store, process, transport, and dispose of “hazardous waste (including radioactive waste) resulting from nuclear materials production, weapons production and surveillance programs, and naval nuclear propulsion programs.”

Again, this AEA authority is limited by any applicable restrictions in the USEC Privatization Act. Section 3112 of that act does not apply to, and thus does not restrict, storage of DOE’s uranium. Section 3113, 42 U.S.C. § 2297h-11, does not apply to or restrict storage of its own depleted uranium, but it is relevant in that it reinforces DOE’s authority to store this type of uranium under the AEA. Section 3113(a) requires DOE to accept depleted uranium from other entities for storage and disposal in the event the depleted uranium is determined to be “low-level radioactive waste.” If the waste generator is a Nuclear Regulatory Commission (NRC) licensee, DOE must take title and possession of the depleted uranium “at an existing

DUF6 [depleted uranium] storage facility.” Implicit in these provisions is that DOE may store and dispose of its own depleted uranium waste as well, under its AEA or other authority.

C. DOE authority to sell or transfer the tails in their current form

DOE has general authority under the AEA to sell or transfer depleted uranium in its current form. As noted, sections 63 and 161m authorize DOE to distribute or sell “source material” to appropriately licensed entities, provided certain conditions are met, and depleted uranium is “source material.” AEA section 11z, 42 U.S.C. § 2014(z).

Again, this AEA authority is limited by any applicable restrictions in the USEC Privatization Act. While this is an issue of first impression, we believe DOE’s authority to sell or transfer depleted uranium in its current form is doubtful. We believe courts applying rules of statutory construction would likely find DOE lacks such authority under current law.

As noted above, section 3112 of the USEC Privatization Act, entitled “Uranium transfers and sales,” begins with a broad prohibition:

“[DOE] shall not . . . transfer or sell *any uranium (including natural uranium concentrates, natural uranium hexafluoride, or enriched uranium in any form) to any person except as consistent with this section.*”

(Emphasis added.) The remainder of section 3112 then prescribes the conditions under which DOE may sell or transfer particular types of uranium, namely, so-called Russian-origin uranium (subsection (b)); natural and enriched uranium transferred to USEC (subsection (c)); natural and low-enriched uranium sold from DOE’s inventory (subsection (d)); and enriched uranium transferred to federal agencies, state and local agencies, nonprofit, charitable or educational institutions, and others (subsection (e)). No provision explicitly addresses depleted uranium.

Read naturally and in accordance with its plain language, section 3112 prohibits DOE from selling or transferring its depleted uranium. The tails consist of uranium-235 and uranium-238, whether they are deemed a waste or a valuable commodity, and a DOE Office of Environmental Management official confirmed to us that operationally, the department treats depleted,

natural, and enriched uranium all as “uranium.” Thus, depleted uranium would be covered by section 3112 as a type of “any uranium.”³ This plain meaning is reinforced by the fact that section 3112(a) lists nonexclusive examples of uranium—“any uranium (including natural uranium . . . or enriched uranium in any form)”—making clear that additional types of uranium are covered by section 3112. A 2005 DOE internal legal memorandum (2005 DOE Memorandum) reaches the same conclusion.⁴ Thus, because DOE may sell or transfer uranium only as consistent with the terms of sections 3112(b)-3112(e), and because none of those provisions specifies conditions under which depleted uranium may be sold, the plain words of the statute prohibit it.

The statutory structure and legislative history support this conclusion. It is clear that when Congress passed the USEC Privatization Act in 1996, it was familiar with depleted uranium as a category of uranium requiring management. Because depleted uranium was only considered as a valueless waste at that time, Congress only explicitly referred to one management option in the statute: disposal.⁵ As noted, in section 3113, Congress required DOE to take responsibility for disposal of other entities’ depleted uranium, should it ever be determined to be a “low-level radioactive waste.” As NRC noted recently in making such a determination, however, when depleted uranium is treated as a “resource,” rather than a waste, section 3113 does not apply. *See* NRC, *In re Louisiana Energy Services, L.P. (National Enrichment Facility)*, No. CLI-05-05 (Jan. 18, 2005), at 1, 3, 15, 17. In that event—where depleted uranium is a resource to be sold or transferred—section 3112, by its terms, would apply. The fact that Congress did not specify section 3112 conditions under which depleted uranium may be sold, as it did for DOE’s other valuable uranium, reflects only that depleted uranium was not

³*See, e.g., Walters v. Metropolitan Educational Enterprises, Inc.*, 519 U.S. 202 (1997) (it is a fundamental principle of statutory construction that words in a statute must be given their ordinary or natural meaning whenever possible); *Ali v. Federal Bureau of Prisons*, 128 S. Ct. 831 (U.S. Jan. 22, 2008) (“[R]ead naturally, the word ‘any’ has an expansive meaning that is, ‘one or some indiscriminately of whatever kind.’”).

⁴The 2005 DOE Memorandum (which DOE indicated may not represent its legal position) states, “it is relatively clear that [section 3112(a)] is applicable to depleted uranium given that it states ‘any uranium.’ The examples of types of uranium are merely a listing and should not be interpreted as a limitation to the broader phrase, ‘any uranium.’”

⁵*See generally Hearing before the Committee on Energy and Natural Resources on S. 755, a Bill to Amend the Atomic Energy Act of 1954 to Provide for the Privatization of the United States Enrichment Corporation*, S. Hrg. No. 104-105, at 5, 9 (June 13, 1995).

deemed valuable in 1996. It does not reflect congressional intent that valuable depleted uranium is not subject to section 3112's general prohibition against sales of "any uranium." While this result may appear anomalous because depleted uranium is now considered a potentially highly valuable commodity and a potential source of revenue for the federal government, that is a matter for Congress to remedy, if it so chooses.

A recently issued DOE policy on disposition of its excess uranium inventory recognizes this increase in value for depleted uranium.⁶ To take advantage of this development, department officials suggested to us that they would be authorized to sell the tails in their current form using DOE's general AEA section 161m authority, without regard to the prohibitions in the USEC Privatization Act. They suggested such an approach might be reconciled as "consistent with" section 3112, as section 3112(a) requires, because none of the provisions in section 3112 specifies conditions of sale for depleted uranium. The 2005 DOE Memorandum makes a similar argument, pointing to the fact that the legislative history contains no explicit mention of restricting DOE's existing AEA authority to sell depleted uranium.⁷

We disagree with this interpretation. DOE in effect reads a depleted uranium exception into the unqualified term "any uranium," and rewrites section 3112 to say that only sale and transfer of uranium categories explicitly identified in that section are restricted. That is not what the statute says, and this reading would violate the principle that statutory exceptions are to be narrowly construed. *See, e.g., Commissioner v. Clark*, 489 U.S. 726, 738-39 (1989) ("Given that Congress has enacted a general rule . . . , we should not eviscerate that legislative judgment through an expansive reading of a somewhat ambiguous exception."). Nor does the legislative history support this result. The fact that there was no mention of limiting DOE's existing depleted uranium sales authority under

⁶*Secretary of Energy's Policy Statement on Management of the Department of Energy's Excess Uranium Inventory*, March 11, 2008, available at <http://www.ne.doe.gov/newsroom/2008PRs/nePR031208.html> (last visited March 20, 2008) (*2008 DOE Policy Statement*), at 4.

⁷The *2008 DOE Policy Statement* similarly asserts that DOE has "broad authority" under the AEA to "loan, sell, transfer or otherwise utilize" the department's depleted, natural and enriched uranium inventories, and that "[i]n exercising this authority, the Department must act *consistently* with other relevant statutory provisions, such as section 3112 . . . which imposes limitations on *certain* specified transactions." *Id.* at 1 (emphasis added).

the AEA is unremarkable, because in 1996, there was no valuable depleted uranium to sell.

Finally, it would not be consistent with section 3112 to allow DOE to sell depleted uranium under the AEA. It would violate the statute's prohibition against sales of "any uranium," because there are no section 3112 exceptions under which its sale is permitted. It would also be incongruous to allow DOE to sell or transfer potentially billions of dollars' worth of federal assets without the scrutiny Congress gave to disposition of DOE's valuable uranium in enacting section 3112. Section 3112 represents Congress' more specific and later-enacted intent regarding the types of factors to be considered in selling DOE's uranium inventories, including price, protection of the domestic uranium industry, and safeguarding the national security, and therefore takes precedence. *See, e.g., Smith v. Robinson*, 468 U.S. 992 (1984) (more specific and recent statute takes precedence).⁸

In sum, we believe our reading of section 3112 carries out the plain words of the act and respects the policy considerations and choices Congress made in 1996 when presented with the disposition of DOE's valuable uranium in a crowded and price-sensitive market. Our reading is also consistent with how courts interpret broad statutes when circumstances change: laws written in comprehensive terms apply to unanticipated circumstances if they reasonably fall within the scope of the plain language. *See, e.g., Unexcelled Chemical Corp. v. United States*, 345 U.S. 59 (1953). Thus, depleted uranium sales are covered by the prohibition in section 3112, even if depleted uranium was not part of the universe Congress explicitly had in mind when it enacted the statute in 1996.

The same concerns that led Congress to legislate explicit conditions of sale for DOE's other uranium inventories in 1996 may apply equally with regard to sale of its depleted uranium inventory today. Congress now has the opportunity to address the intervening increase in uranium values and balance the competing concerns associated with its sale. Because the

⁸Section 3112(d) of the USEC Privatization Act authorizes DOE's sale of its natural and low-enriched uranium inventories only if it receives "not . . . less than fair market value," determines that the domestic uranium mining, conversion, and enrichment industry will not suffer adverse material impact from the sale, and obtains a determination by the President that the material is not needed for national security. By contrast, AEA section 161m authorizes sale of DOE's depleted uranium inventory to NRC licensees if there is "reasonable compensation to the government."

question of DOE's authority to sell its depleted tails would be a statutory construction issue of first impression and thus is not free from doubt, and because the question is an issue of significant public interest and importance, we recommend that Congress consider enacting legislation setting forth the explicit conditions (if any) under which DOE may sell or transfer its depleted uranium. Depending on the terms of such legislation, this could reap significant benefits for the government because of the potentially significant revenue that could be obtained. In any event, enacting explicit provisions regarding DOE's sale or transfer of its depleted uranium would provide stakeholders with welcome legal clarity and help avoid litigation that could interrupt DOE's efforts to obtain maximum value for the public.

Conclusion

In summary, we conclude that DOE has general authority under the Atomic Energy Act to re-enrich and then sell or transfer the tails, provided the transaction meets the conditions of section 3112 of the USEC Privatization Act. DOE also has general AEA authority to store the tails indefinitely. However, we believe that because of constraints on DOE's AEA authority in the USEC Privatization Act, the department's authority to sell or transfer tails in their current form is doubtful and that under rules of statutory construction, DOE likely lacks such authority under current law. We recommend that Congress consider enacting legislation explicitly addressing the scope of DOE's authority to sell and transfer depleted uranium.

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